Evidence of Nematicity in the Optical Properties of FeSe

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FeSe undergoes a structural tetragonal-to-orthorhombic transition below 90 K, which breaks the four-fold rotational symmetry of the tetragonal phase, without any subsequent onset of magnetic ordering. The substantial anisotropy of the transport properties in the broken symmetry state is ascribed to an electronic nematic phase. FeSe thus provides an opportunity to address the impact of nematicity on its intrinsic physical properties without the limitations of the reconstruction of the Fermi surface due to the SDW collective state in the orthorhombic phase, typical for several other iron-based superconductors. We describe results of reflectivity measurements over a broad spectral range that probe the optical response to variable uniaxial stress, detwinning the specimen and acting as an external symmetry breaking field, and as a function of temperature across the structural transition [1]. We extract the optical conductivity through Kramers-Kronig transformation. Our data reveal an astonishing anisotropy of the optical response in the mid-infrared-to-visible spectral range, which bears testimony of an important polarization of the underlying electronic structure in agreement with ARPES results. Our findings at high energy scales support models for the nematic phase based on an orbital-ordering mechanism, supplemented by orbital selective band renormalization. The far-infrared response of the charge dynamics moreover allows establishing the link to the dc resistivity. The dc limit of the optical conductivity indeed agrees with the measured transport properties, deploying an anisotropy typical of hole-doped iron-based materials. Our optical results at energies close to the Fermi level furthermore emphasize scenarios based on scattering by anisotropic spin-fluctuation, shedding new light on the origin of nematicity in FeSe.

References

[1] M. Chinotti et al., Phys. Rev. B, **96**, 121112(R) (2017)